

Sub- μ m-scale investigations for metasomatic PGM–BMS inclusion in Tahitian harzburgite xenolith

*Norikatsu Akizawa¹, Akira Miyake², Yohei Igami², Tetsu Kogiso³

1. Atmosphere and Ocean Research Institute, The University of Tokyo, 2. Graduate School of Science, Kyoto University, 3. Graduate School of Human and Environmental Studies, Kyoto University

Platinum-group element (PGE) in mantle peridotites have been targeted as a geochemical tracer of core-mantle evolution, as it is highly siderophile. Meanwhile, ascending melts produced by partial melting of the mantle potentially disturb the PGE composition recorded during early Earth's history. To fully facilitate the PGE as the geochemical tracer of core-mantle evolution, mineralogical and geochemical characteristics of metasomatic PGE host minerals, such as base-metal sulfides (BMSs) and platinum-group minerals (PGMs), should be properly investigated in metasomatized mantle peridotites.

A PGE–BMS inclusion in harzburgite xenolith from Tahiti island (Society Archipelago) was intensively investigated in the scale of sub-micrometer, employing transmission electron microscope with energy dispersive X-ray spectrometer (TEM-EDS). The sulfide inclusion is of metasomatic origin as it is enveloped by carbonaceous glass (21.2 at% C), and forms inclusion array with other sulfide–carbonaceous glass inclusions in host clinopyroxene crystal. The Tahitian harzburgite xenolith is, therefore, sufficiently suitable to elucidate metasomatic behavior of PGE through carbonatitic metasomatism in the mantle.

With the mineralogical and geochemical investigations by the TEM-EDS, the sulfide phases were identified: monosulfide solid solution (MSS), pentlandite, sugakiite, heazlewoodite, chalcopyrite, and Cu-Ir-Pt-Rh-thiospinel (cuproiridsite–malanite–cuprorhodsites). Considering empirical evidence, the first crystallization product from metasomatic sulfide melt was primary MSS below 1,000 °C. The primary MSS was recrystallized into Fe-rich MSS (33.8 at% Fe, and 16.6 at% Ni), Ni-rich MSS (9.7 at% Fe, and 42.9 at% Ni), Fe-rich pentlandite (21.5 at% Fe, and 33.6 at% Ni), Ni-rich pentlandite (15.2 at% Fe, and 39.8 at% Ni), sugakiite, and heazlewoodite at low temperatures down to 500 °C, where Ni-rich pentlandite and heazlewoodite can coexist. During the recrystallization process, most of Cu contained in the primary MSS was absorbed into the sugakiite (6.9 at% Cu). The other Cu-rich sulfides such as chalcopyrite (25.7 at% Cu) and Cu-Ir-Pt-Rh-thiospinel (15.1 at% Cu, 26.5 at% Ir, 8.2 at% Pt, and 1.2 at% Rh) were crystallized directly from evolved Cu-rich sulfide melt after the primary MSS crystallization below 760 °C. Therefore, the PGE was preferentially partitioned into the evolved Cu-rich sulfide melt. The preferential partitioning of PGE into the evolved Cu-rich sulfide melt is attributed to high metal/sulfur ratio (~1.2). The coupling mobility of Ir, Pt, and Rh might function in the case of metasomatic activity involving carbonatitic melts in the mantle.

Keywords: thiospinel, sugakiite, carbonatitic metasomatism, FE-TEM-EDS, metasomatic PGE mobilization